

Bicycle Helmet Laws and Educational Campaigns: An Evaluation of Strategies to Increase Children's Helmet Use

ABSTRACT

Objectives. The passage of a mandatory bicycle helmet law for children in Howard County, Maryland, provided an opportunity to compare legislation and education as strategies to increase helmet use.

Methods. In 1991, a survey was mailed to fourth-, seventh-, and ninth-grade students attending a stratified sample of public schools in Howard County and in two similar suburban/rural counties without helmet laws.

Results. Of 7217 students surveyed, 3494 responded (48.4%). Self-reported helmet use in Howard County rose from 11% to 37% after the law and accompanying educational campaign went into effect. Helmet use changed from 8% to 13% in Montgomery County, where educational efforts were undertaken, and from 7% to 11% in Baltimore County, where helmet promotion activities were minimal. Predictors of helmet use included having friends who wore helmets, believing helmet laws are good, being in fourth grade, living in Howard County, and using seatbelts regularly.

Conclusions. Legislation combined with education appears to increase bicycle helmet use substantially more than does education alone. The Howard County law may be considered a successful model of a strategy to increase children's helmet use. (*Am J Public Health*. 1993;83:667-674)

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Introduction

Bicycling for both recreation and transportation is a popular activity in the United States. Bicycle-related injuries are receiving increasing attention as a public health issue; each year approximately 960 persons (55% of whom are under age 20) die and 558 000 persons (79% of whom are under age 20) are treated in emergency departments as a result of such injuries.¹ Head injury is the primary or contributing cause of death in 70% to 80% of all bicycle-related fatalities.² Bicycle helmets have been shown to be highly effective in reducing the risk of bicycle-related head injuries,^{2,3} yet only a small proportion of children wear helmets while riding.⁴⁻⁸

Education and legislation are among the strategies available to persuade individuals to change their behavior to reduce the risk of injury. Educational efforts to increase children's bicycle helmet use have been sporadic, have generally been conducted at school, and have seldom been evaluated. An intensive community-wide educational campaign in Seattle did not convince the majority of child bicyclists to wear helmets.^{9,10} When education alone is insufficient, legislation mandating helmet use may be a more effective approach.

In 1990, a law was passed in Howard County, Maryland, that requires persons younger than 16 years of age riding bicycles on county roads and paths to wear an approved safety helmet. As the first of its kind in the United States, the law evoked widespread interest from local and national news media concerning the costs, benefits, and social acceptability of such legislation. In one adjacent county, a large-scale educational campaign was un-

der way to promote bicycle helmet use; in a second adjacent county there were no special initiatives related to helmets. These three counties provide a unique opportunity to compare the effects of legislation and education on the wearing of bicycle helmets.

The Johns Hopkins University Injury Prevention Center and the Maryland Department of Health and Mental Hygiene collaborated on a multifaceted evaluation of the impact of the Howard County law. Because of the low number of severe bicycle-related head injuries expected each year in the county, we focused on changes in helmet use rates rather than injury rates. The first component of the evaluation, a mailed survey of school children in the three counties, is described in this report. The second component, "before" and "after" roadside observations of helmet use, is described elsewhere.¹¹

The mailed survey was designed to assess differences in helmet use rates over time and across three conditions: legislation and education, education alone, and

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no special initiatives. We examined a number of characteristics associated with helmet use, so that children at high risk for noncompliance with the law and for non-use of helmets in general can be identified and future efforts to promote helmet use can be targeted appropriately. Study results have implications for promoting behavioral change in other areas of injury prevention.

Methods

Setting

The survey was conducted in three Maryland counties that are predominantly suburban and rural. The first adjacent county selected for comparison with Howard County was Montgomery County, which had extensive educational helmet promotion efforts in progress. In the second adjacent county, Baltimore County (which excludes Baltimore City), there had been no substantial legislative or educational helmet promotion activities. Based on US census data, the 1990 populations of Baltimore, Howard, and Montgomery counties were 692 000, 187 000, and 757 000 persons, and the 1988 per capita incomes were \$20 418, \$19 089, and \$27 831, respectively.

The bicycle safety educational campaign in Montgomery County in 1990 included (1) a bicycle safety school poster contest, to which more than 1000 children submitted posters; (2) distribution to elementary teachers and school nurses of more than 2000 workbooks emphasizing methods for teaching bicycle safety at various grade levels; (3) distribution through schools, fairs, and other sites of approximately 10 000 coupons for discounts on helmets; (4) promotion of bicycle safety, by means of videos, literature, and discount coupons, at approximately 20 local fairs; and (5) promotion of bicycle safety on cable television and radio talk shows and in local newspaper articles, as well as a proclamation on bicycle safety by the county executive that received media attention.

The bicycle safety educational campaign in Howard County in 1990 included (1) distribution of a handbook on bicycle safety to all elementary and middle school students; (2) increased emphasis on bicycle safety as part of the health education classes in all elementary schools; (3) incorporation of a bicycle safety curriculum into physical education courses at some but not all middle schools; (4) promotion of bicycle helmets and related safety is-

suues at bicycle rodeos held at some but not all middle schools; and (5) promotion of bicycle safety as part of local news media coverage of the new law.

Survey Instrument

After reviewing the literature, the investigators developed and pretested the survey instrument, which focused on knowledge, attitudes, and practices related to bicycles and helmets. Specific questions included in this report focused on bicycle ownership and use, helmet ownership and use, awareness of the helmet law, sources of information about helmets, the effect of peer pressure on helmet use, and history of bicycle-related injuries. Questions on frequency of behavior were rated on a 4-point scale from "Always" to "Never." Questions soliciting attitudes were rated on a 5-point scale from "Strongly disagree" to "No opinion" to "Strongly agree." The final instrument included 43 questions and took 10 to 15 minutes for children to complete. Copies of the survey instrument are available from the senior author.

Sample

The survey was administered to children in the fourth, seventh, and ninth grades to span the age range from the lowest grade considered able to respond to a mailed survey to the highest grade in which almost all students would be covered by the law in Howard County. After stratification by geographic location within each of the three counties, a total of 47 schools were randomly selected. In each county, surveys were sent to the parents of (1) all fourth-grade students in 9 elementary schools (10 in Baltimore County), (2) all seventh-grade students in 3 middle schools (4 in Howard County), and (3) all ninth-grade students in 3 high schools. The cover letter asked parents to have their child complete the survey without help and to return it anonymously in an enclosed preaddressed stamped envelope. Reminder postcards were sent 10 to 20 days after the initial mailing.

Surveys were sent to 2712, 2278, and 2332 students in Baltimore, Howard, and Montgomery counties, respectively. Surveys were mailed in May 1991 in Montgomery County, in June 1991 in Howard County (8 months after the law went into effect), and in October 1991 in Baltimore County. Mailing dates were determined by dates when approval to conduct the survey was obtained from the public school administrators in each county.

Statistical Methods

All analyses, except those related to bicycle ownership and use, excluded respondents who reported they did not ride a bicycle. In addition, responses for specific questions that were missing, uncodeable, or answered "Don't know," "No opinion," "Don't remember," or "Doesn't apply" were excluded from analyses except where indicated otherwise.

Univariate and bivariate data analyses were done using the EPI INFO software package developed by the Centers for Disease Control. For most bivariate results, chi-square analysis was used for testing statistical significance. Considering the large number of tests of significance performed in these analyses, results for which $P < .01$ are considered statistically significant and those for which $.05 < P < .01$ are considered marginally significant. Logistic regression analyses were done using Statistical Analysis System software (SAS Institute, Cary, NC). The study protocol was reviewed and exempted by the Johns Hopkins School of Public Health Committee on Human Research because the survey contained no sensitive questions and was anonymous and voluntary.

Results

Response Rates

Response rates were calculated using denominators that excluded surveys returned as undeliverable (58, 16, and 31 in Baltimore, Howard, and Montgomery counties, respectively). The overall response rate was 48.4% (3494/7217). The county-specific rates were 47.7% in Baltimore County, 51.2% in Howard County, and 46.5% in Montgomery County. For fourth-, seventh-, and ninth-grade students, the response rates were, respectively, 48%, 53%, and 41% in Baltimore County; 59%, 52%, and 43% in Howard County; and 47%, 46%, and 47% in Montgomery County. Assuming student enrollment is evenly balanced by gender in each county, response rates for boys and girls were, respectively, 48% and 47% in Baltimore County, 50% and 52% in Howard County, and 44% and 49% in Montgomery County.

Bicycle and Helmet Ownership and Use

Bicycle ownership was high among respondents in all counties, exceeding 85% in each of the three grades in each county (Table 1). The proportion of re-

TABLE 1—Children's Self-Reported Bicycle and Helmet Ownership and Use, by County and Grade, Maryland, 1991

	Baltimore County			Howard County			Montgomery County			Total/ Average
	4th Grd	7th Grd	9th Grd	4th Grd	7th Grd	9th Grd	4th Grd	7th Grd	9th Grd	
No. respondents ^a	367	515	360	401	398	342	323	445	299	3450
Own a bicycle, %	97	94	86	98	92	87	94	89	90	92
Ride a bicycle, %	96	95	89	97	93	90	96	93	93	94
Ride at least a few times per month, %	88	83	72	94	79	61	92	79	64	80
Ride at least a few times per week, %	62	53	40	70	49	34	72	47	40	52
Own a helmet, % ^b	30	21	16	75	51	28	34	30	8	33
Wore helmet on last ride, % ^b	17	10	9	56	26	12	20	13	4	19
Always or usually wore a helmet when bicycling in past month, % ^b	17	8	9	61	28	15	20	13	3	20

^aThe denominators used to calculate percents vary slightly owing to a few missing or uncodeable responses on some questions.

^bExcludes survey respondents who indicated that they did not ride a bicycle.

spondents who rode bicycles was slightly higher than the proportion who owned them, presumably reflecting use of bicycles owned by siblings or friends. In the three counties combined, the proportion of respondents who rode their bicycles at least a few times per month was significantly higher among fourth-graders (91%) than among ninth-graders (66%) ($P < .0001$).

Among respondents who ride a bicycle, helmet ownership was significantly higher in Howard County than in the other two counties ($P < .0001$). Helmet ownership was significantly higher among fourth-graders than among ninth-graders in each of the three counties ($P < .0001$). The proportion of bicyclists who reported owning a helmet but not wearing it the last time they rode a bicycle ranged from 4% among Montgomery County ninth-grade students (8% ownership and 4% use) to 25% among Howard County seventh-grade students (51% ownership and 26% use) (Table 1).

We defined wearing a helmet on one's most recent bicycle ride as consistent with "always" or "usually" wearing a helmet while riding in the past month; similarly, not wearing a helmet on one's most recent ride was defined as consistent with "sometimes" or "never" wearing a helmet in the past month. When these definitions were used, the responses on helmet use on most recent ride and in past month were consistent in 96% of the surveys ($P < .0001$).

Changes in Helmet Use

Respondents were asked how often they wore a helmet when bicycling 1 year ago (before the Howard County law went

TABLE 2—Bicycle Helmet Use by Children, Based on Self-Report and Direct Observation in Three Maryland Counties in 1990 and 1991

	Self-Reported Helmet Use ^a			Observed Helmet Use ^b		
	% Reporting Helmet Use "Always" or "Usually"	No. 95% CI Responses		% Observed Wearing Helmet	No. 95% CI Observations	
Baltimore County						
Before	7	5, 8	1164	19	5, 33	37
After	11	9, 13	1060	4	0, 11	49
Howard County						
Before	11	9, 13	1056	4	0, 10	69
After	37	34, 41	929	47	32, 62	51
Montgomery County						
Before	8	7, 10	995	8	3, 13	140
After	13	10, 15	888	19	11, 27	102

Source. Observed data are reprinted from Coté et al.^{11(6:1216)} with permission of *Pediatrics*. Copyright © 1992 *Pediatrics*.

^a"Before" and "After" refer to self-reported helmet use when bicycling in previous year (1990) and in past month (1991), respectively. Results exclude survey respondents who indicated that they did not ride a bicycle.

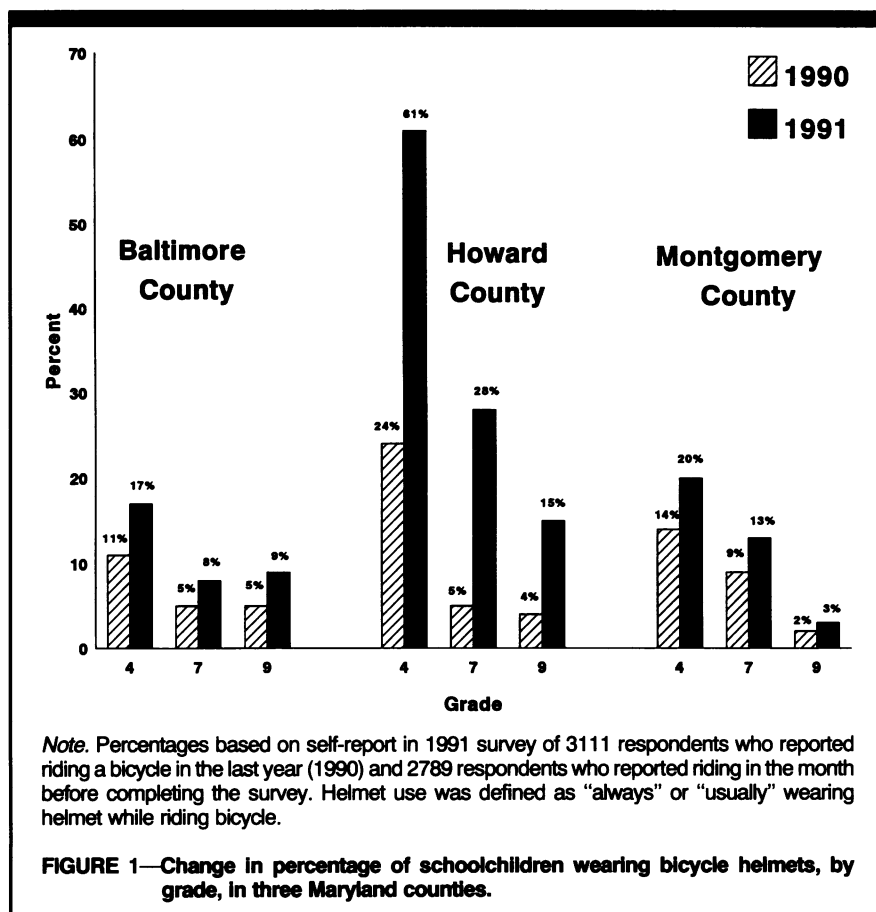
^b"Before" refers to helmet use observed on July 28, 1990; "After" refers to helmet use observed on May 4, 1991.

into effect) and how often they wore it in the past month. The proportion of respondents who reported that they "always" or "usually" wore a helmet increased from 11.4% for last year to 37.5% for the past month ($P < .0001$) in Howard County (Table 2). The corresponding increases were from 8.4% to 12.6% in Montgomery County ($P < .01$) and from 6.7% to 11.1% in Baltimore County ($P < .001$). In Howard County, the absolute increase in helmet use from last year to past month was greater for fourth-graders (from 24% to 61%) than for ninth-graders (from 4% to 15%) (Figure 1); the overall use rate in-

creased from 12% to 38% for boys and from 11% to 36% for girls. Although the changes in helmet use were smaller in Baltimore and Montgomery counties, the patterns of differences by grade and gender were similar to those found in Howard County.

Awareness of the Law

Respondents were asked whether there was a law requiring helmet use by children where they lived. In Howard County, 87% of the respondents who rode bicycles thought there was such a law, 4% thought there was not, and 10%



did not know. The corresponding proportions were 7%, 51%, and 41% in Montgomery County, where a mandatory helmet law was under active consideration during data collection in May 1991; the law finally passed (but did not go into effect) in June 1991, after more than 90% of the survey forms had been returned. The proportions in Baltimore County (where no such law was under consideration) were 6%, 67%, and 27%, respectively. In Howard County, of respondents who were aware that there was a mandatory helmet law, 38% wore helmets on their last ride, compared with 14% of those who thought there was no law ($P < .01$) and 17% of those who did not know if there was a law ($P < .0001$) (Table 3).

Correlates of Helmet Use

In the following analyses, helmet users are defined as those bicyclists who reported wearing their helmets the last time they rode. In both county-specific and grade-specific analyses, respondents who agreed with the statement "Laws that make children wear bike helmets are good" were more likely to be helmet users than were those who disagreed with the

statement ($P < .0001$). In each county, respondents whose friends wore helmets were significantly more likely to wear helmets than were those whose friends did not wear helmets ($P < .0001$) (Table 3). For respondents in grades 4, 7, and 9, helmet use rates were, respectively, 78%, 71%, and 55% among those who reported that all or most of their friends usually wore helmets, compared with 20%, 11%, and 6% among those who reported that some or none of their friends usually wore helmets ($P < .0001$).

Respondents who reported always or usually using a seat belt were more likely to be helmet users than were those who reported sometimes or never using a seat belt in Baltimore County ($P < .001$) and Howard County ($P < .0001$), but not in Montgomery County ($P = .20$). Analyses of both county-specific and grade-specific data showed that respondents who had been personally injured in a bike accident or who had a friend who had been injured in a bike accident were not significantly more likely to be helmet users than were those who had no such exposure to personal or peer injury (Table 3).

Sources of Information about Helmets

Respondents were asked to indicate (from a list) all sources from which they had received information about bicycle helmets. School, parents, and television were the sources most commonly mentioned by children who rode bicycles in all three counties (Table 4). The proportions of respondents in each grade mentioning school, parents, and friends were similar in Baltimore and Montgomery counties; these proportions were higher in Howard County than in the other two counties. In each county, the proportion of children who reported receiving information about helmets from parents and school was higher for fourth-graders than for ninth-graders ($P < .0001$). Other major sources of such information included newspapers, magazines, and radio. The proportion of children who reported receiving information about helmets from physicians was less than 20% in each grade in each county.

To estimate the impact of various information sources in promoting bicycle helmets, we compared the sources reported by helmet users and nonusers (Table 5). Helmet users were more likely than nonusers to have heard about helmets from parents in all counties ($P < .0001$) or from school in Baltimore and Montgomery counties ($P < .01$). The likelihood of having heard about helmets from television, radio, magazines, or newspapers did not differ between helmet users and nonusers. In Baltimore County, 9% of the respondents who indicated three or fewer information sources were helmet users, compared with 18% of those who indicated more than three sources ($P < .0001$). The corresponding helmet use rates were 31% and 40% in Howard County ($P < .01$) and 10% and 19% in Montgomery County ($P < .001$).

Multivariate Analysis

The variables with the strongest bivariate associations with helmet use were entered sequentially into a logistic regression model. In this multivariate model (Table 6), the strongest predictors of helmet use were having all or most friends usually wear helmets (odds ratio [OR] = 8.4), agreement that helmet laws are good (OR = 3.1), being in the fourth grade (OR = 2.4), and living in Howard County (OR = 2.3). Other significant predictors of helmet use included always or usually wearing a seat belt (OR = 2.1); hearing about helmets from parents, teachers,

doctors, or friends (OR = 1.9); and hearing about helmets from four or more sources (OR = 1.4). Riding a bicycle at least a few times a week was a marginally significant predictor of helmet use (OR = 1.3).

Discussion

Although a very high proportion of the school children who responded to this survey rode bicycles, most respondents reported that they did not routinely wear bicycle helmets. The large increase in the helmet use rate reported after the mandatory helmet law went into effect in Howard County suggests that such laws can have a major impact. By contrast, the increase in self-reported helmet use in Montgomery County during the time of educational efforts was substantially smaller and was not significantly different from that seen in Baltimore County, where no special county-wide initiatives to promote helmet use were undertaken. Considering that educational efforts preceded and were subsequently expanded as part of the implementation of the Howard County law, these results indicate that legislation combined with education increased helmet use substantially more than did education alone.

It is important to note that a large proportion of Howard County children, especially teenagers, continue to ride bicycles unhelmeted even in the presence of the law. Parents, teachers, physicians, bicycle retailers, local news media, and children can all play a major educational role in encouraging compliance with the law. Ideally, it should be possible to achieve high compliance without needing rigorous enforcement activities by the local police. Laws similar to the one in Howard County have been passed in a few other jurisdictions, including Victoria, Australia,¹² in 1990 and New Jersey in 1991.

The results obtained in this study are similar to those in the observational study,¹¹ in which it was found that helmet use rates in children increased from 4% in 1990 to 47% in 1991 in Howard County and did not change significantly in the other two counties. The two studies are complementary; considering the similar results obtained, each approach helps validate the other study. Observational studies are necessarily limited to the finite number of sites and times during which observations can be recorded; in contrast, the present study includes self-reports of helmet use from children regardless of when and where they rode their bicycles.

TABLE 3—Correlates of Children's Self-Reported Bicycle Helmet Use, Maryland, 1991

	Respondents Who Reported Wearing a Helmet the Last Time They Rode a Bicycle ^a					
	Baltimore County		Howard County		Montgomery County	
	No.	%	No.	%	No.	%
Knowledge of law ^b						
Yes	17/67	25	332/885	38	14/70	20
No	81/780	10***	5/36	14**	57/503	11
Don't know	40/316	13*	17/101	17†	55/405	14
Helmet law is good ^c						
Agree	116/640	18	290/589	49	99/547	18
Disagree	6/277	2†	28/237	12†	14/225	6†
Friends wear helmets ^d						
All or most	40/68	59	204/250	82	37/63	59
Some or none	96/1089	9†	146/755	19†	86/909	9†
Wear seat belt ^e						
Always or usually	134/1026	13	343/936	37	116/863	13
Sometimes or never	4/137	3***	13/87	15†	11/119	9
Ever injured on bike ^f						
Yes	14/121	12	40/94	43	13/90	14
No	119/1029	12	313/919	34	113/890	13
Friend ever injured ^g						
Yes	45/377	12	83/274	30	43/309	14
No	62/542	11	150/492	30	46/410	11

^aExcludes survey respondents who indicated that they did not ride a bicycle
^b"Where you live, is there a law now that makes children wear a bike helmet?"
^c"Laws that make children wear bike helmets are good."
^d"How many of your friends usually wear bike helmets when they ride?"
^e"How often do you wear your seat belt when you ride in a car?"
^f"Have you ever been hurt so badly in a bike accident that you had to go to a doctor?"
^g"Have any of your friends ever been hurt so badly in a bike accident that they had to go to a doctor?"
^{*}*P* < .05; ^{**}*P* < .01; ^{***}*P* < .001; [†]*P* < .0001.

TABLE 4—Reported Sources of Information about Bicycle Helmets, by County and Grade, Maryland, 1991

Information Source	Respondents Who Reported Having Heard about Helmets from Specified Information Source ^a								
	Baltimore County			Howard County			Montgomery County		
	4th Grd	7th Grd	9th Grd	4th Grd	7th Grd	9th Grd	4th Grd	7th Grd	9th Grd
No. bicycle riders ^b	350	484	317	388	370	305	311	411	273
School, %	59	39	26	88	85	61	47	46	25
Parents, %	55	44	31	72	66	56	54	53	30
Friends, %	29	26	24	44	51	46	33	28	20
Doctor, %	17	14	10	14	9	6	13	16	9
Television, %	60	70	74	64	68	70	60	72	76
Radio, %	18	19	21	20	19	27	14	21	16
Magazine, %	19	39	37	28	28	29	24	39	38
Newspaper, %	18	29	29	33	47	52	19	30	28
Other, % ^c	12	16	12	13	14	10	11	16	12

^aFrom responses to the question "Where have you heard anything about bike helmets? Circle all that apply to you."
^bExcludes survey respondents who indicated that they did not ride a bicycle.
^cOther responses included bicycle stores (n = 116), relatives other than parents (n = 69), observation of helmeted bicyclists (n = 27), police (n = 20), and the survey itself (n = 19).

Helmet ownership and helmet use were substantially higher among younger

respondents in all three counties. Ninth-graders may have spent more years riding

TABLE 5—Reported Sources of Information about Bicycle Helmets Indicated by Child Respondents Who Did and Did Not Wear Helmets, Maryland, 1991

Information Source	Respondents Who Heard about Helmets from Specified Information Source					
	Baltimore County		Howard County		Montgomery County	
	Helmet Users	Helmet Nonusers	Helmet Users	Helmet Nonusers	Helmet Users	Helmet Nonusers
No. bicycle riders ^a	136	987	354	640	125	833
School, %	52	39**	84	77**	46	39
Parents, %	83	37***	80	58***	78	42***
Friends, %	45	23***	51	46	36	26*
Doctor, %	22	13**	16	7***	21	13*
Television, %	67	68	63	70	66	70
Radio, %	18	19	23	21	12	18
Magazine, %	40	31	31	28	38	34
Newspaper, %	24	26	42	45	26	26

^aExcludes survey respondents who indicated that they did not ride a bicycle.
P* < .05; *P* < .01; ****P* < .0001.

TABLE 6—Variables Associated with Helmet Use on Most Recent Bicycle Ride, Based on Survey of Schoolchildren: Logistic Regression Model, Maryland, 1991 (n = 3117)

	Odds Ratio	95% CI	<i>P</i>
Friends usually wear helmets			
All or most	8.4	6.4, 10.9	< .0001
Some or none	1.0		
Helmet law is good			
Agree	3.1	2.4, 4.0	< .0001
Disagree	1.0		
Grade			
Fourth	2.4	1.8, 3.3	< .0001
Seventh	1.9	1.4, 2.6	.0001
Ninth	1.0		
County of residence			
Howard County	2.3	1.8, 2.9	< .0001
Baltimore or Montgomery County	1.0		
Seat belt use			
Always or usually	2.1	1.3, 3.3	.0017
Sometimes or never	1.0		
Received information about helmets from parents, teachers, doctors, or friends			
Yes	1.9	1.3, 2.8	.0009
No	1.0		
No. sources of information about helmets			
Four or more	1.4	1.1, 1.8	.0039
Fewer than four	1.0		
Frequency of bicycle riding			
A few times per week or more	1.3	1.0, 1.6	.0505
Once per week or less	1.0		

bicycles without helmets than fourth-graders and may be less receptive to being told to wear helmets, either by parents or legislators. Ninth-graders also ride their bicycles less frequently and may therefore perceive less need to own or wear a helmet.

Comparison with Other Studies

The self-reported helmet use rates in Howard County after the law went into effect are higher than those documented in communities without mandatory helmet laws. On the basis of observations of 468

bicyclists commuting to school in Tucson, Ariz, Weiss reported helmet use rates of 2% for bicyclists in elementary school, 0% for those in junior high school, 2% for those in high school, and 10% for university students.⁸ On the basis of roadside interviews of 516 bicyclists in Burlington, Vt, Wasserman et al. reported helmet use rates of 4% for bicyclists aged 11 to 19 years, 8% for those aged 20 to 29 years, and 16% for those aged 30 years and older.⁷ DiGiuseppi et al., using the results of a mailed survey, reported a helmet use rate of 13% among 931 third-grade students in Seattle, Wash, who owned bicycles.⁵ Selbst et al. reported that fewer than 1% of 520 children treated in a Philadelphia, Pa, emergency room for bicycle-related injuries were wearing any protective equipment at the time of injury.⁶ In a 1990 national survey of 11 631 high school students, 2.3% of those who rode bicycles reported wearing a helmet "always" or "most of the time" when bicycling.⁴

An evaluation of a community-wide bicycle helmet campaign in Seattle, Wash, was reported by DiGiuseppi et al.¹⁰ The campaign included physician education of parents about helmets, extensive advertising in the newspapers and on television and radio, numerous presentations in schools, and discount coupons for helmets.⁹ Observed helmet use among 4940 school-aged bicyclists rose from 5% in 1987 (baseline) to 16% in 1988¹⁰ and to 25% in 1989.¹³ In the comparison community of Portland, Ore, helmet use rates increased from 1% in 1987 to 4% in 1988 (rates based on observations of 4887 school-aged children).¹⁰

Correlates of Helmet Use

Awareness of the law is very high in Howard County, suggesting that efforts to inform children about the law were successful. Self-reported compliance with the law was higher among children who believed the law was good than among those who did not. Consistent with previous reports,^{5,14} the perception that peers use helmets appears to be one of the strongest determinants of helmet use. A strong association was also found between using seat belts (as required by state law) and wearing bicycle helmets.

Having been injured on a bicycle appears to have relatively little effect on the decision to wear a helmet. This finding is comparable to a report by Cushman et al. that fewer than 10% of 334 children treated in an emergency room for bicycle-related injuries purchased helmets in the subsequent 6 weeks, even if active counseling

was given by the attending physician.¹⁵ In another study, Nakayama et al. reported that helmet use in injured children increased from 7% before a bicycle-related injury to 24% after such an injury.¹⁶ Having a friend who sustained a bicycle-related injury appears to have little or no impact on the personal decision to wear a helmet.

The major sources of information about bicycle helmets identified by children in all three counties are school, parents, and television. Such findings may be helpful for designing new educational campaigns to promote helmet use. The finding that helmet users were more likely than nonusers to have received information about helmets from school and parents suggests that these routes may be more influential than mass media alone in convincing students to wear helmets. Because children receiving information about helmets from multiple sources appear to be more likely to wear helmets than those with information from fewer sources, educational campaigns using multiple information sources may have the highest probability of success.

Relatively few children reported receiving information about helmets from their physicians, possibly because most healthy school children do not have frequent contact with physicians. Although a recent survey indicates that most pediatricians discuss the importance of helmets with their patients,¹⁷ other studies suggest that physicians are relatively ineffective in influencing the use of bicycle helmets by children.^{15,18,19}

Limitations

With an overall survey response rate of 48%, it is important to determine whether the nonrespondents differed significantly from the respondents. Children participating in the survey were assured that their participation was voluntary and anonymous; therefore it was not possible to resurvey a sample of nonrespondents. Response rates by grade varied from 41% among Baltimore County ninth-graders to 59% among Howard County fourth-graders. Approximately equal numbers of responses were received from boys and girls in each county. It is not possible to determine whether children who do not ride bicycles were less likely to respond to the survey; the high bicycle ownership rates in this study are comparable to those in a previous report from Vermont, which found that 80% to 90% of children in grades 2 through 6 owned bicycles.²⁰ Because most of the analyses excluded those

who do not ride bicycles, most results would not be affected if nonriders were underrepresented among the survey respondents.

Although self-report may overestimate actual use of a safety device,²¹ the validity of the survey data is supported by the similarities between the self-reported helmet use rates in this study and the observed helmet use rates reported by Coté et al. for the same three counties.¹¹ Within each county, the 95% confidence intervals overlapped for the helmet use rates by self-report and by observation related to 1990 ("before"); similar overlapping confidence intervals were noted for the rates related to 1991 ("after") (Table 2). These similarities suggest that there probably were not substantial biases in our data due to different response rates for helmet users and nonusers. The validity of our data is also supported by anecdotal reports of increased helmet sales by Howard County bicycle stores after the law passed and by informal observations by the Howard County Police Department of increased helmet use by children during 1991.

Several other limitations should also be considered in interpreting the results of this study. Despite assurances of anonymity, some children may have given socially desirable responses that did not represent their actual beliefs or practices; parents were instructed not to guide the child to a "correct" response and to assist only if the child had difficulty in understanding a question. In responding to the question about helmet use 1 year earlier, some children may not remember accurately when they obtained their helmets. Some of the differences in frequency of bicycle use between counties may relate to the different months during which the surveys were conducted in the three counties. The survey was conducted at a sample of suburban and rural schools in three Maryland counties whose populations are predominantly in the middle and upper socioeconomic classes; the responses may not be representative of bicycle riders in poorer and more urban areas. Finally, although the Howard County law applies to all bicyclists younger than 16 years, no information is available from this survey on the knowledge, attitudes, and practices of children younger than fourth-grade age.

Public Health Implications

Overall, our study results indicate that legislation combined with education is more effective than education alone in modifying children's behavior for the purpose of increasing bicycle helmet use.

Compliance with new regulations appears to be higher among elementary school children than among teenagers. Personal experience with injury appears to have relatively little effect on future behavior to reduce risk of injury.

Considering that helmet use rates differ substantially by age, strategies to increase helmet use need to be targeted to specific age groups. Such strategies should take advantage of the additive influence of multiple sources of information. Public health planners working to change behavior to reduce injury risk should be aware that messages conveyed by parents, schools, and peer role models are likely to be effective complements to mass media efforts. The present study's results provide clear support for the use of legislation as a means to increase personal protective behavior. The success of the Howard County law may influence similar helmet legislation nationally. □

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